Book of abstracts of the

II International Symposium on Bee Products
Annual meeting of the International Honey Commission

September 9-12, 2012

School of Agriculture

Polytechnic Institute of Bragança

Bragança

Portugal

Edited by

Miguel Vilas-Boas

Luís Guimarães Dias

Luís Miguel Moreira

PC30. Evaluation of an electronic tongue for honey classification according to its pollen analysis.

Mara E.B.C. Sousa (1)*; Luís G. Dias (1); António M. Peres (1,2); Letícia Estevinho (1); Adélio A.S.C. Machado (3)

1: CIMO - Escola Superior Agrária, Instituto Politécnico de Bragança, Bragança, Portugal
2: LSRE - Laboratory of Separation and Reaction Engineering - Associate Laboratory, LSRE/LCM, Escola Superior Agrária, Instituto Politécnico de Bragança, Portugal
3: LAQUIPAI - Departamento Química, Faculdade de Ciências, Universidade do Porto, Portugal

Electronic tongues (ET) have attracted great interest due to its potential to obtain global information from complex samples that could hardly be obtained by traditional instrumental methods of analysis. These multi-sensor arrays provide a huge amount of sample information which, by applying chemometric methods, allows sample identification/classification, taste evaluation as well as, multicomponent analysis. The method of operation consists in obtaining a signal pattern which corresponds to the overall information on the sample using chemical sensors with high stability and cross sensitivity to different species in solution.

In this work, a potenciometric electronic tongue or taste sensor array was used. The device had 20 sensors, based on all-solid-state electrodes with lipid polymeric membranes formed on solid conducting silver supports.

This analytical system was used to analyse unifloral honeys, which honey pollen profiles were obtained by pollinic analysis, that are representative of eight main types of pollens: *Castanea sp.*, *Echium sp.*, *Erica sp.*, *Eucalyptus sp.*, *Lavandula sp.*, *Prunus sp.*, *Rubus sp.* and *Trifolium sp.*.

The signal profile information obtained from the ET analysis of the honey samples was related with the pollinic analysis, using linear discriminant analysis. The results showed that ET could be used for classifying the type of honey according to their pollen profile, when the main pollen is in great abundance, being a possible alternative to traditional honey classification techniques that are time consuming and require expert labour. The influence of the second main pollen showed to be relevant in honey classification.

Acknowledgements: *Collaboration of the Portuguese National Beekeepers Federation in providing honey samples is gratefully acknowledged.*

* *Presenting author: mebdias@iol.pt*

Evaluation of an electronic tongue for honey classification according to its pollen analysis

Mara E.B.C. Sousa (1)*, Luís G. Dias (1), António M. Peres (1,2), Letícia Estevinho (1), Adélio A.S.C. Machado (3)

1:CIMO - Escola Superior Agrária, Instituto Politécnico de Bragança, Portugal
2:LSRE - Laboratory of Separation and Reaction Engineering - Associate Laboratory, LSRE/LCM, Escola Superior Agrária, Instituto Politécnico de Bragança, Portugal
3:LAQUIPAI - Departamento Química, Faculdade de Ciências, Universidade do Porto, Portugal

*) mebdias@iol.pt

FLOWER → POLLEN, NECTAR → HONEY with representative amount of POLLEN

INTRODUCTION

ELECTRONIC TONGUE (ET)
(taste sensor array)

Chemical sensors with high stability and cross sensitivity to different species in solution

OBTAIN
signal pattern which corresponds to the overall information on the sample

APPLY
chemometric methods

ALLOW
sample identification/classification
taste evaluation
multicomponent analysis

ELECTRONIC TONGUE

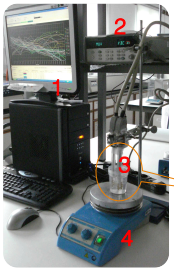
Potentiometric device
(all-solid-state electrodes)

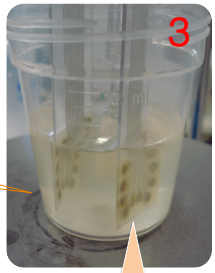
20 lipid polymeric membranes
Double junction Ag/AgCl reference electrode
Multiplexer Agilent Data Logger Acquisition

Each **lipid polymeric membrane** has (see Table):
31.9-32.3% of PVC;
64.7-65.2% of one of the plasticizers;
2.8-3.2% of one of the membrane additives.

Additives and plasticizers used for polymeric membranes preparation

Membrane Additive substance
[1] Octadecylamine *[2] Oleyl alcohol* *[3] Methyltrioctylammonium chloride* *[4] Oleic acid*
Plasticizer substance
[A] Bis(1-butylpentyl) adipate *[B] Dibutyl sebacate* *[C] 2-Nitrophenyl-octylether* *[D] (2-ethylhexyl)phosphate* *[E] Dioctyl phenylphosphonate*





Analysis with two sensor arrays: 40 sensors

Figure 2 – Multi-sensor analytical system:
1 - PC for data acquisition;
2 - DataLogger Agilent;
3 - Etongue device;
4 - Magnetic stirrer.

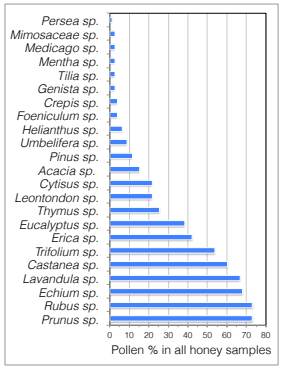
ELECTRONIC TONGUE ANALYSIS

Honey sample dissolved in water
(10g per 50 mL of H_2O)

78 HONEY SAMPLES

POLLEN ANALYSIS

Pollen frequency in honey samples



Min %	Max %
6.9	6.9
1.2	11.4
4.7	11.2
2.3	3.0
5.1	19.9
2.6	5.4
3.7	24.3
1.8	5.1
1.4	8.7
1.5	6.6
1.6	6.1
0.6	63.6
1.5	20.1
1.2	7.1
1.3	17.8
1.2	82.0
1.2	81.7
1.5	81.7
3.2	94.8
1.2	66.5
1.4	79.3
1.1	68.6
1.4	80.1

Global results

- 23 varieties of pollen
- 9 pollens as the most predominant:
  Acacia sp. *Castanea sp.* *Echium sp.*
  Erica sp. *Eucalyptus sp.* *Lavandula sp.*
  Prunus sp. *Rubus sp.* *Trifolium sp.*
- As second most predominant pollen also appears:
  Leontondon sp. *Foeniculum sp.*

Honey samples classification

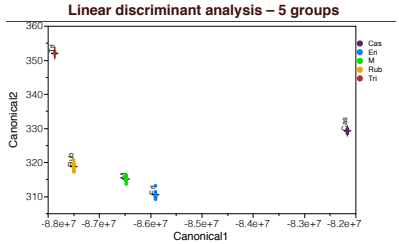
1) Monofloral honeys → 8 GROUPS
- % of pollen in honey:
  > 90% *of Castanea sp.* – *4 samples*
  > 45% of *Erica sp.* – *8 samples*
  > 45% of *Echium sp.* – *15 samples*
  > 70% *of Eucalyptus sp.* – *2 samples*
  > 45% of *Prunus sp.* – *4 samples*
  > 45% of *Rubus sp.* – *13 samples*
  > 45% of *Trifolium sp.* – *3 samples*

Dominant pollen:
> 15% of *Lavanda sp.* – *17 samples*

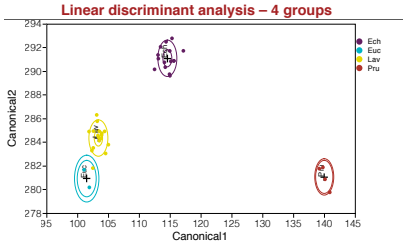
"OUTLIER" – 63.6% of *Acacia sp.* – *1 sample*
(honey not common)

2) Multifloral honeys → 1 GROUP
- Pollen % do not meet the requisites of honey monofloral
- *12 samples*

ZONE 1
Linear discriminant analysis – 5 groups

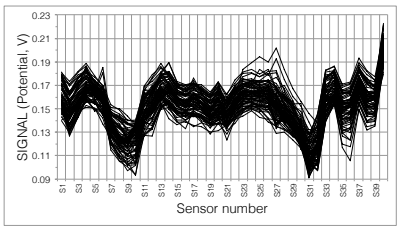


ZONE 2
Linear discriminant analysis – 4 groups

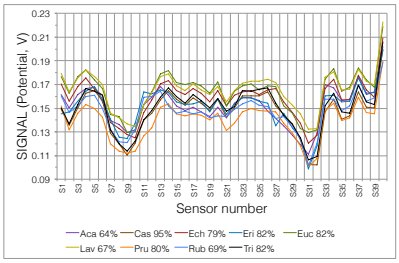


ELECTRONIC TONGUE ANALYSIS

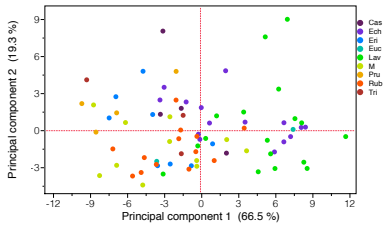
Honey signal profile of all honey samples



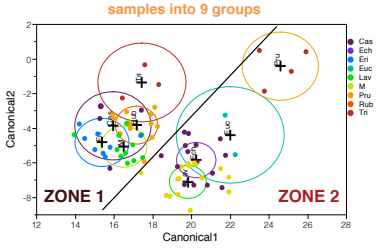
Honey signal pattern of samples with high percentage of the predominant pollen



Principal component analysis with marks accordingly to honey samples classification



Linear discriminant analysis to classify honey samples into 9 groups



CONCLUSIONS

The honeys' ET signal profile can be used to classify the type of honey according to their pollen profile.
100% of correct classification was obtained within model training if honeys are separated into two groups:
Group 1 – Castanea, Erica, Rubus and Trifolium monofloral honeys, including also multifloral honey;
Group 2 – Echium, Eucalyptus, Lavandula and Prunus monofloral honeys.

Acknowledgements: Collaboration of the Portuguese National Beekeepers Federation in providing honey samples is gratefully acknowledged.